Predicting and Responding to Drought and Flood

What's the issue?

During times of drought, local water tables can decline due to decreased recharge and increased demand for groundwater supplies. This puts shallow drinking water and irrigation wells at risk of going dry, which can lead to reduced drinking water availability or crop yield. These water table declines also affect water levels in streams, lakes, and wetlands, with important consequences for aquatic life and recreational value. Even where groundwater quantity remains sufficiently high to meet demands, declines in water table level can alter water chemistry and expose residents using groundwater for drinking water to more heavy metals, organics, and other contaminants.

Too much groundwater can also be a problem. Groundwater flooding occurs when extremely intense and frequent rainfall leads to excessively fast recharge of local groundwater levels, causing the water table to rise above the land surface. This type of flood can be very long-lasting because water table decline requires drainage of an entire aquifer. For the months that it takes for this drainage to occur, flood waters cause significant property loss, human displacement, and disruption of transportation. Seepage lakes may also experience flooding of shoreline beaches and buildings due to a rise in the water table elevation and the related long-term increase in lake levels.

Floods and droughts are part of life in Wisconsin and elsewhere, but they come with significant economic, public health, and environmental costs. Being able to predict where these events are likely occur, how often they may take place, and probable impacts is critical to reducing the damage. The Groundwater Coordinating Council (GCC) encourages the development of data and analyses of likely scenarios for quantity and quality of Wisconsin's groundwater supply.

GCC in Action: *June 2008 Flooding in Spring Green*

A dramatic example of groundwater flooding in Wisconsin occurred when Southern Wisconsin experienced record amounts of precipitation from August 2007 through July 2008. While most of the initial flooding occurred as surface water overflow, longer-term groundwater flooding remained for many weeks or months following the rain events. In Spring Green, about 4,400 acres of land several kilometers away from the floodplain of the Wisconsin River remained flooded by high groundwater for over

Flooding in Spring Green, WI in June 2008. *Photo: WI ASCE*

five months. Recovery in the Spring Green area included a $5.4 million Federal Emergency Management Agency (FEMA) grant in 2009 to acquire and demolish 28 flood damaged homes (Moynihan, 2009).

Groundwater flooding is rare and little studied in Wisconsin. Given the extent of the damage to agricultural, residential, and commercial properties caused by the 2008 flooding, questions about the future likelihood of groundwater inundation naturally arose. Researchers at the Wisconsin Geological and Natural History Survey and UW-Madison funded by the Wisconsin Groundwater Research and Monitoring Program (WGRMP) responded by developing a series of models that simulated groundwater hydrology in the low-lying areas near Spring Green under a range of climate scenarios through 2100. Findings suggest that years of extremely high water table conditions may still occur but will remain relatively rare in this century (Joachim et al., 2011). Higher evapotranspiration is likely to reduce groundwater recharge overall.

The 2008 floods also highlighted the need for improved mitigation, preparation, response, and recovery practices. Capitalizing on momentum, a GCC-sponsored conference, "From Sandbags to Sanity," brought together policy experts, state and local officials, and nonprofit organizations in April 2009 to discuss the policy approaches that can minimize the risks associated with this type of hydrologic disaster (Moynihan, 2009).

These two responses to the June 2008 floods – investment in research to improve scientific knowledge and enhanced coordination among federal, state, and local actors – exemplify how the GCC carries out its core missions to enhance the effectiveness and efficiency of groundwater management.

Other Projects in Other Places

Agricultural management in the Central Sands

Corn suffering in July 2012, one of the worst droughts on record in Wisconsin. *Photo: DATCP*

In times of drought, the demand for agricultural irrigation increases substantially, especially in the Central Sands region of the state. For immediate relief, the Department of Natural Resources may approve emergency high capacity wells for irrigation or livestock supply, as it did during the 2012 drought. On a long-term basis, a more reliable strategy for farmers and water systems requires understanding water balance dynamics and crop biophysics at higher spatial and temporal resolutions so that process-based models can be used to evaluate the effects of different irrigation strategies and climates on water demand. To this end, a recent study funded by the WGRMP conducted an intense field measurement campaign to refine models and evaluate how climate and land management have impacted groundwater recharge and evapotranspiration in the Wisconsin Central Sands over the past 60 years (Kucharik et al., 2015). Initial results indicate that irrigation increases the demand for water for evaporation and plant

use (potential evapotranspiration), which has important implications for regional estimates of water demand.

Building Resilience Against Climate Effects (BRACE)

The Department of Health Services BRACE program has worked with seven local public health departments, or consortiums of health departments, to facilitate a climate and health community engagement process. Two of the seven local health department pilot projects have chosen to address public health impacts related to groundwater in a changing climate. One such consortium of local health departments (Eau Claire Co., Dunn Co., Pepin Co., and Buffalo Co.) is developing better policy regulating nutrient contaminants (e.g., nitrates, phosphorous). Activities will include increased testing and a collaborative group to problem-solve public health interventions. Another local health department pilot project in La Crosse County is working to increase public awareness of drinking water hazards and increase testing among private well owners. This project successfully received funding from the CDC for private well water testing.

Another aspect of the BRACE framework focuses on projecting disease burden related to a changing climate. One projected disease burden the BRACE program is investigating is gastrointestinal illness related to increases in precipitation from a changing climate in Marshfield.

References

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